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UNDERSTANDING MOBILITY AS THE RESULT OF THE CITY USE, IN SPACE AND TIME

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Basic question

Can we reorganize mobility if we don’t know why, when, and where the people move?

When we know the different pattern of the use of the city, and more specific of the use of the different activities in the city, then we can evaluate the impact of a transport project, in the sense of the social system that they affect.

The pattern of mobility-use the city is important to reorganize the mobility, and not only the efficiency of different transport system

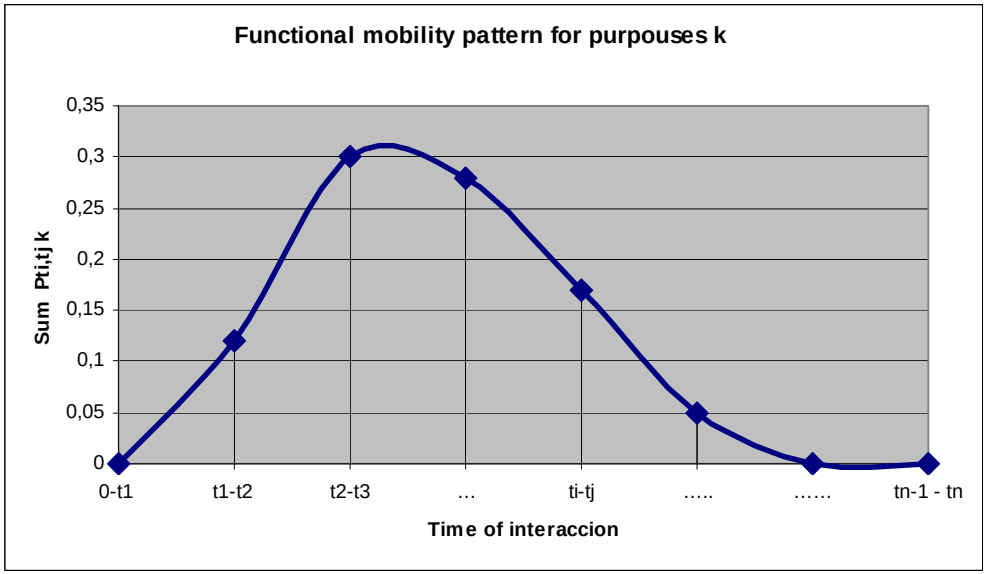
Urban models

The developed urban models explain the location considering, among others, a variable of general accessibility, which definition and understanding are divergent and ambiguous.

Our investigation raises a new dimension of accessibility (functional probability), that it is constructed with the population pattern of mobility (how the people travel in the city).

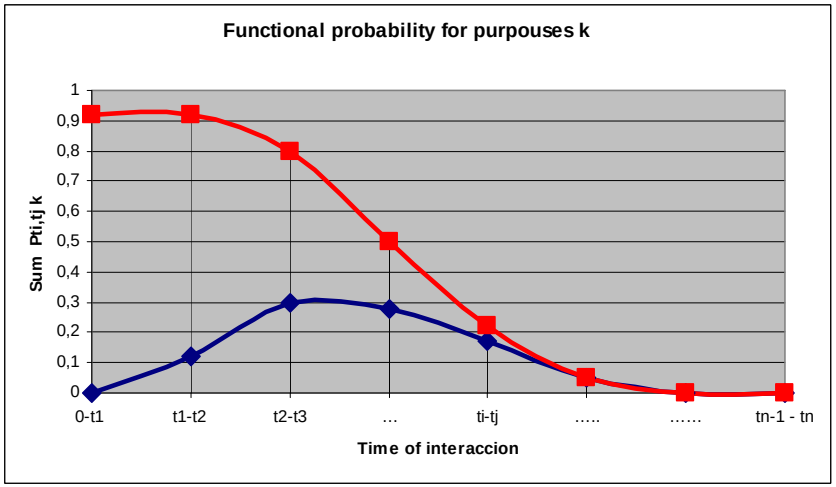
Mobility pattern for purpouses of travel K

Time	Funtional mobility pattern for purpouses k
t1 – t2	$P_{t1,t2}^{k}$
t2 – t3	$P_{t2,t3}^{k}$
…..	…
ti - tj	$P_{ti,tj}^{k}$
…	…..
….	……
tn-1 - tn	$P_{tn-1,tn}^{k}$
TOTAL	1.00



Functional probability for purpouses K

Time	Funtional probability for purpouses k
t1 – t2	Ptn-1,tn k+……+…..+Pti,tj k+…+Pt2,t3 k+Pt1,t2 k = 1.00
t2 – t3	Ptn-1,tn k+……+…..+Pti,tj k+…+Pt2,t3 k
…..	Ptn-1,tn k+……+…..+Pti,tj k+…
ti - tj	Ptn-1,tn k+……+…..+Pti,tj k
…	Ptn-1,tn k+……+…..
….	Ptn-1,tn k+……
tn-1 - tn	$P_{tn-1,tn}^{k}$



Mobility pattern of travel in Santiago (STG) and Barcelona (BCN)

Travel distance

Year 2001	Travel to study			Travel to work			Travel to shop		
Percentil	BCN (Km)	STG (Km)	**BCN-STG (Km)**	BCN (Km)	STG (Km)	**BCN-STG (Km)**	BCN (Km)	STG (Km)	**BCN-STG (Km)**
10	0,4	0,5	**-0,1**	1,0	1,1	**0,0**	0,3	0,3	**0,0**
20	0,8	0,9	**-0,1**	1,4	2,4	**-1,0**	0,6	0,6	**0,1**
40	1,4	2,1	**-0,6**	2,5	6,0	**-3,5**	1,3	1,2	**0,0**
50	1,7	2,9	**-1,2**	3,5	8,1	**-4,6**	1,6	1,8	**-0,2**
60	2,0	4,2	**-2,2**	4,7	10,4	**-5,7**	1,9	2,7	**-0,8**
80	5,0	8,4	**-3,4**	8,7	15,8	**-7,1**	3,7	6,7	**-3,0**
90	9,5	12,3	**-2,9**	13,8	20,5	**-6,6**	6,3	10,3	**-4,0**

Travel time

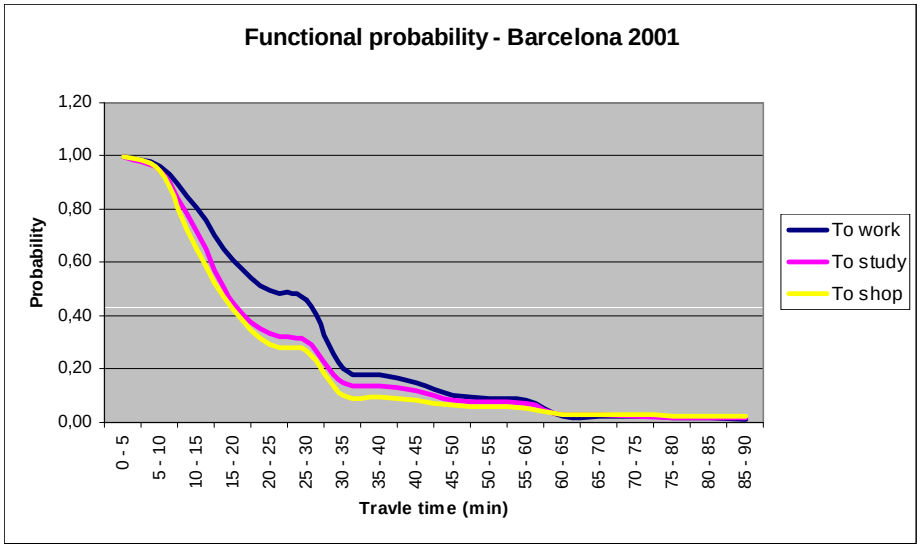
Año 2001	Travel to study			Travel to work			Travel to shop		
Percentil	BCN (min)	STG (min)	**BCN-STG (min)**	BCN (min)	STG (min)	**BCN-STG (min)**	BCN (min)	STG (min)	**BCN-STG (min)**
10	6,0	5,3	**0,7**	6,9	6,8	**0,1**	5,8	2,6	**3,2**
20	8,2	8,0	**0,2**	10,1	12,0	**-1,9**	7,5	5,1	**2,4**
40	12,2	13,6	**-1,4**	15,4	23,2	**-7,8**	11,1	9,1	**2,0**
50	14,0	16,9	**-2,9**	19,7	28,6	**-8,9**	13,3	11,5	**1,8**
60	17,0	21,0	**-3,9**	26,2	36,6	**-10,5**	15,8	14,3	**1,5**
80	28,4	33,1	**-4,7**	30,3	56,7	**-26,3**	27,1	25,8	**1,3**
90	42,6	45,7	**-3,0**	44,9	73,2	**-28,3**	32,4	37,3	**-4,9**

The travel distance and time are statistical distribution……the average time or distance is not a good value to conclude something, but in general there are asymmetric functions.

Functional probability for Barcelona 2001

Barcelona - 2001

	Functional probability		
Travel time (min)	To work	To study	To shop
0 - 5	1,00	1,00	1,00
5 - 10	0,96	0,95	0,95
10 - 15	0,80	0,72	0,65
15 - 20	0,61	0,44	0,42
20 - 25	0,49	0,33	0,29
25 - 30	0,46	0,31	0,27
30 - 35	0,20	0,15	0,10
35 - 40	0,18	0,14	0,10
40 - 45	0,15	0,12	0,08
45 - 50	0,10	0,08	0,06
50 - 55	0,09	0,08	0,06
55 - 60	0,08	0,07	0,06
60 - 65	0,03	0,03	0,03
65 - 70	0,02	0,03	0,03
70 - 75	0,02	0,03	0,03
75 - 80	0,02	0,02	0,03
80 - 85	0,02	0,02	0,02
85 - 90	0,01	0,02	0,02
90 - 95	0,01	0,01	0,02
95 - 100	0,01	0,01	0,02
100 - 105	0,01	0,01	0,02
105 - 110	0,01	0,01	0,02
110 - 115	0,01	0,01	0,01
115 - 120	0,01	0,01	0,01
120 and more	0,00	0,01	0,01



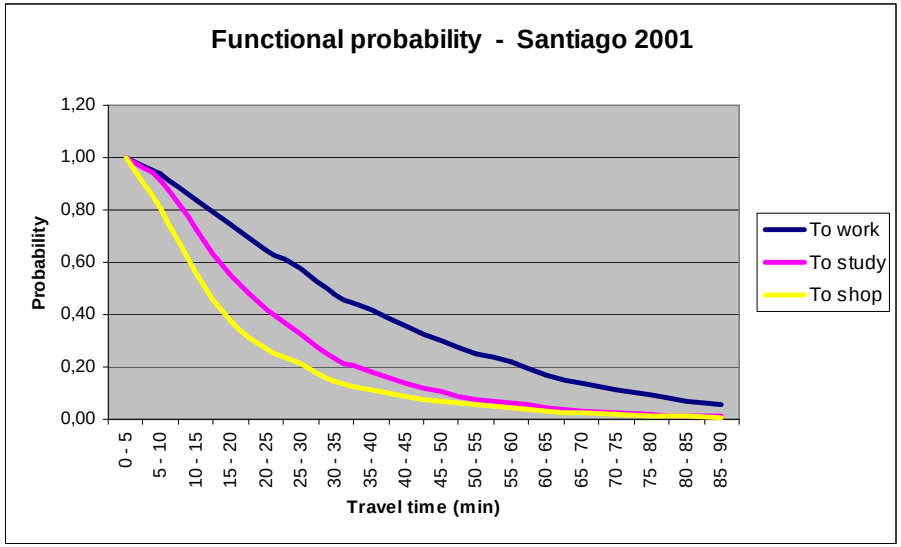
Each purpose has a particular inertia to travel.

The distribution is not only an exponential function

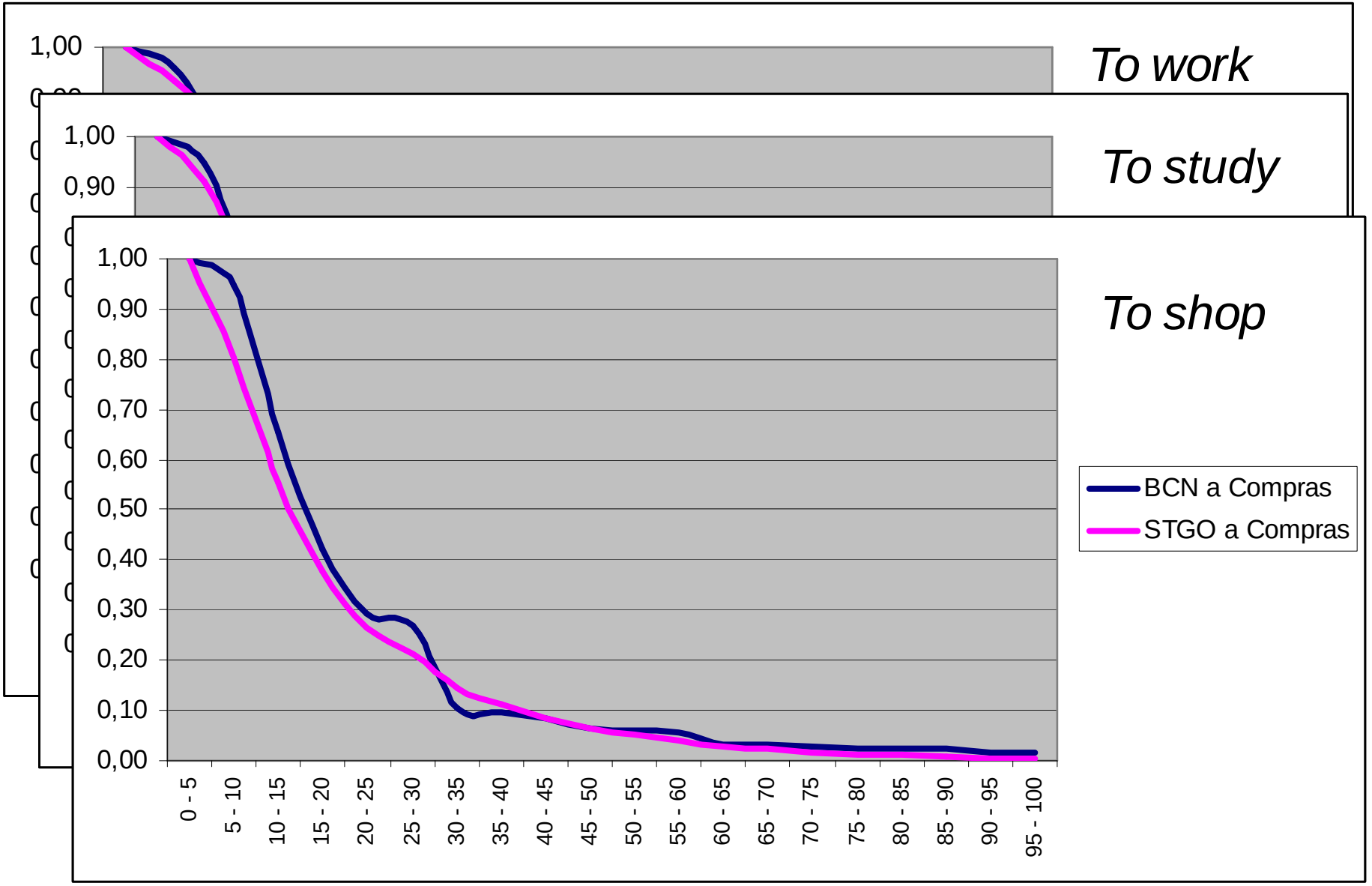
Functional probability for Santiago 2001

Santiago - 2001

	Functional probability		
Travel time (min)	To work	To study	To shop
0 - 5	1,00	1,00	1,00
5 - 10	0,93	0,91	0,80
10 - 15	0,84	0,73	0,56
15 - 20	0,74	0,55	0,38
20 - 25	0,64	0,42	0,27
25 - 30	0,58	0,33	0,21
30 - 35	0,47	0,23	0,15
35 - 40	0,42	0,18	0,11
40 - 45	0,36	0,14	0,09
45 - 50	0,30	0,10	0,07
50 - 55	0,25	0,08	0,05
55 - 60	0,22	0,06	0,04
60 - 65	0,17	0,04	0,03
65 - 70	0,14	0,03	0,02
70 - 75	0,11	0,02	0,02
75 - 80	0,09	0,02	0,01
80 - 85	0,07	0,01	0,01
85 - 90	0,06	0,01	0,01
90 - 95	0,04	0,01	0,01
95 - 100	0,03	0,01	0,00
100 - 105	0,03	0,00	0,00
105 - 110	0,02	0,00	0,00
110 - 115	0,01	0,00	0,00
115 - 120	0,01	0,00	0,00
120 and more	0,01	0,00	0,00



Comparing functional probability between Santiago and Barcelona 2001



Similarity with different structure

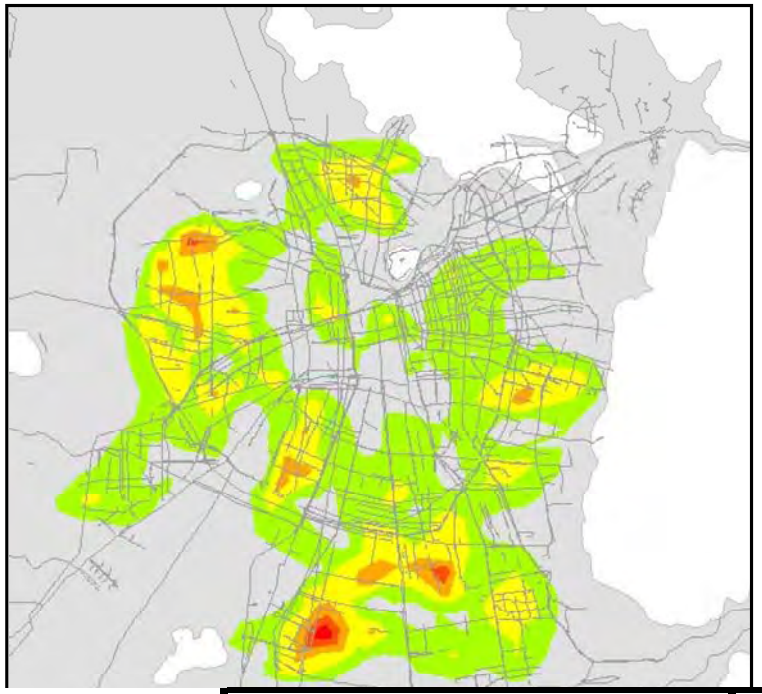
The functional probability, in both cities, shows a statistical similarity in the purposes to shop and to study, but a dissimilarity in the travel to work purpose.

The travel to work is highly elastic, in comparison to the inelastic behavior of travel to shop or to study.

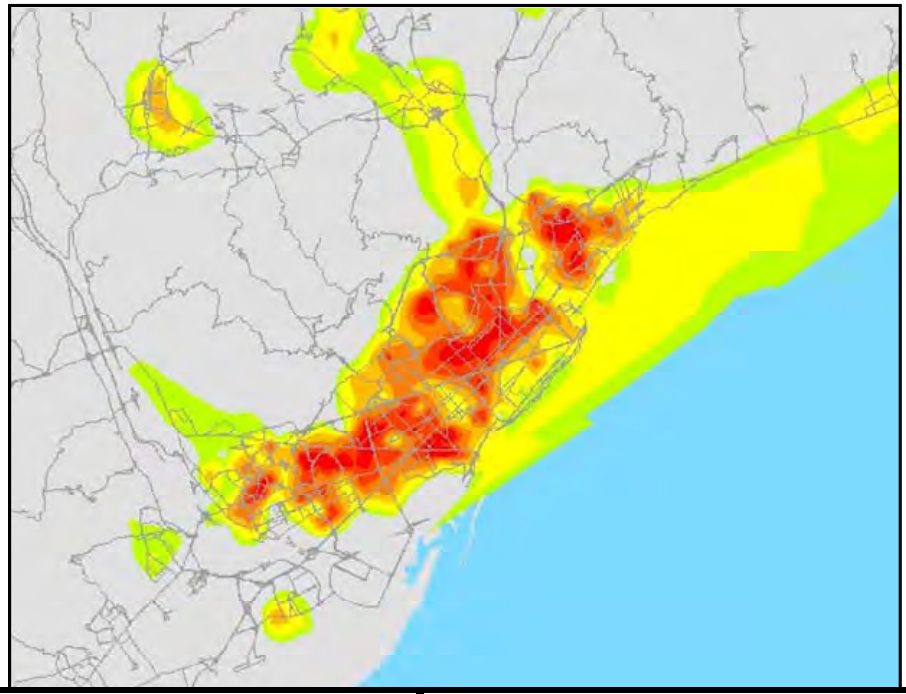
This result are interesting in the sense that Barcelona and Santiago are structurally different, since Santiago has more population, is more extensive, and has more number of trips.

Population density 2001

Santiago



Barcelona



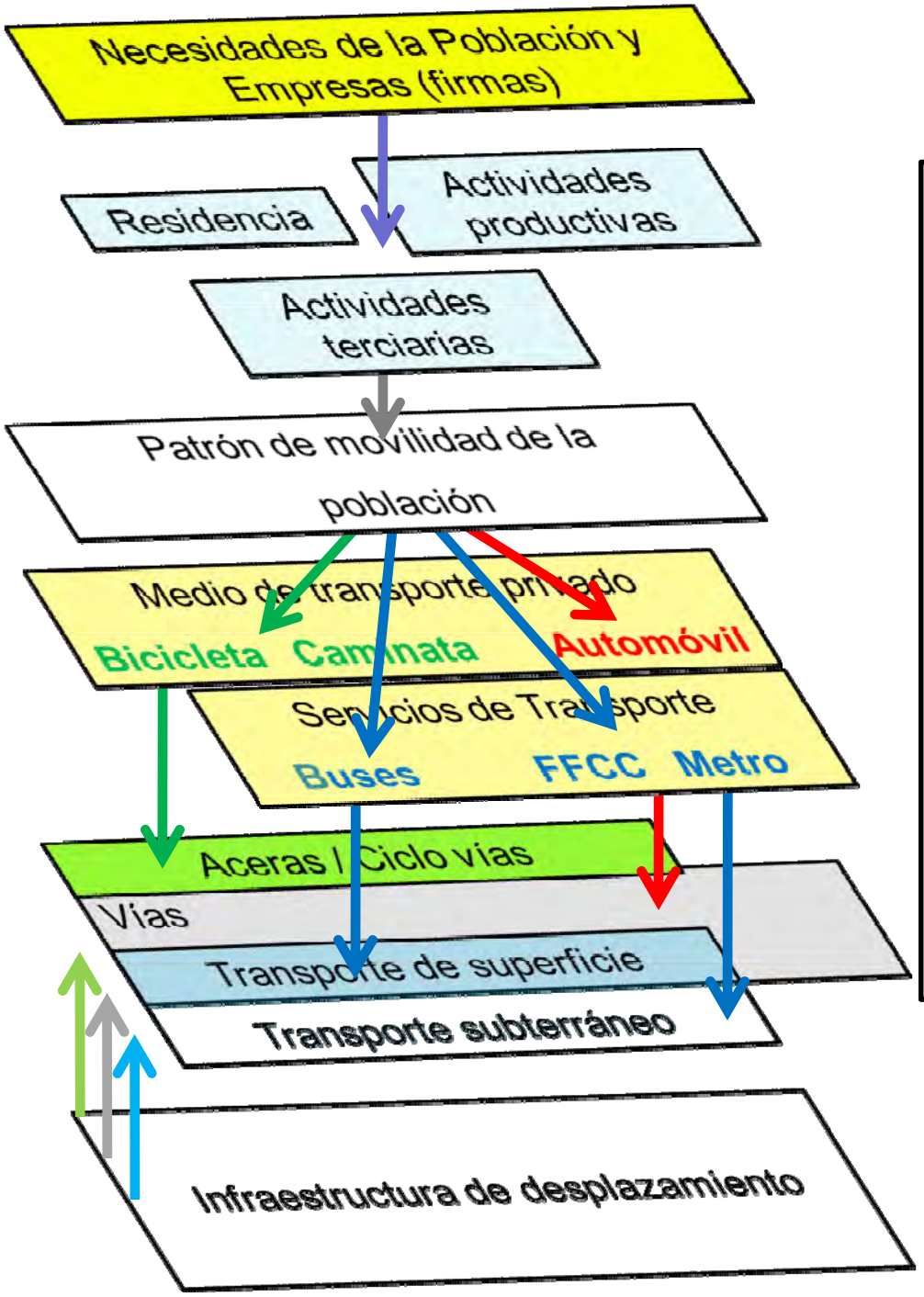
	Población Urbana		Area urbanizada (ha)		Densidad (hab/ha)	
Año	Gran Santiago	RM Barcelona	Gran Santiago	RM Barcelona	Gran Santiago	RM Barcelona
1940	982.893	1.681.826	11.017		89	
1952	1.436.870	1.966.291	15.351		94	
1960	1.996.142	2.566.733	21.165		94	
1970	2.820.936	3.579.072	31.841		89	
1982 / 1981	3.902.356	4.234.725	42.080		93	
1992 / 1991	4.754.901	4.299.790	49.270	48.951	97	88
2002 / 2001	5.456.326	4.372.980	64.140	51.044	85	86
2007*	5.898.954	4.856.579				
Var 92-02 (%)	**14,8**	**1,7**	**30,2**	**4,3**	**-11,9**	**-2,5**

* proyección en base a censos

This approach generated the doubt of the validity of this situation in other cities

The first stage of the investigation it is based on the new paradigm of understanding the integration of the mobility (transport) in a territorial system. The approach of causal analysis is change with this new paradigm, who understands that mobility is a part more of a social territorial system.

This new approach, have not develop a method, in comparison with the development of the causal analysis, mainly of the approach of the classic transportation model



1.- Need of population and activities

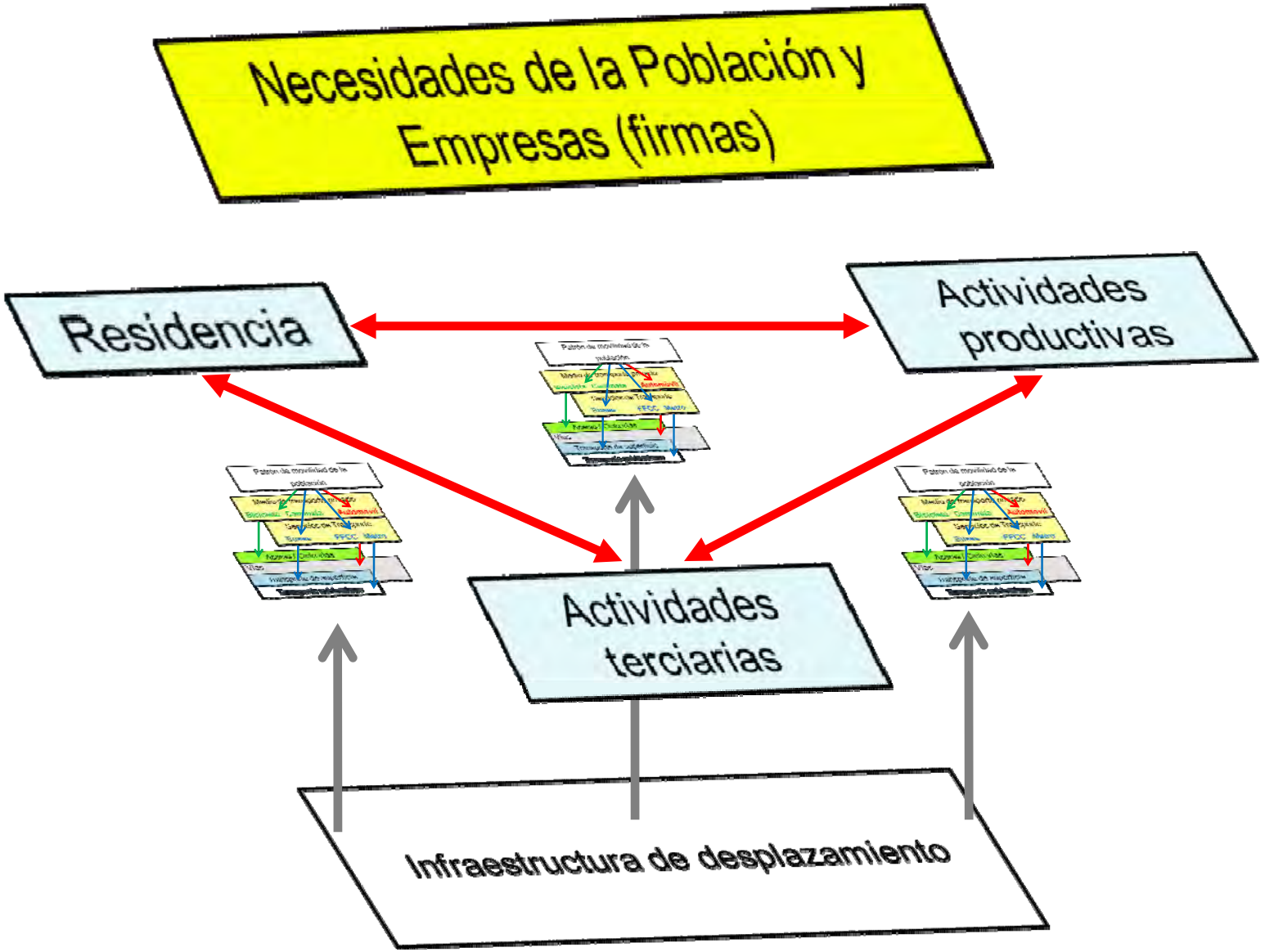
2.- Location pattern of activities

3.- Movility pattern of population

4.- Transport service

5.- Network flow

6.- Infrastructure to flow

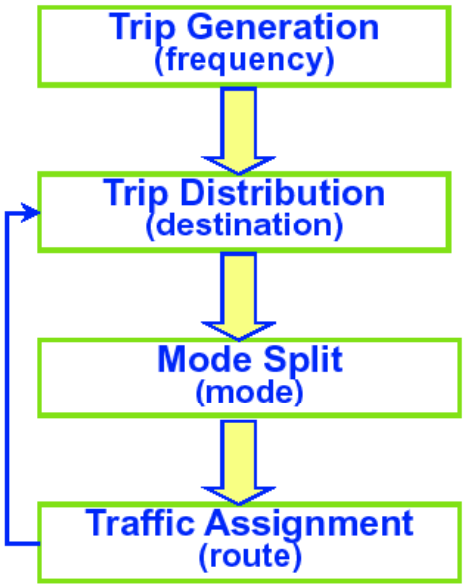


New paradigm : transport is part of the social spatial system

In this way, there is a new type of transport model based on the activity path of the people (trip chain)

The activity based models

Features of the Trip-based Approach

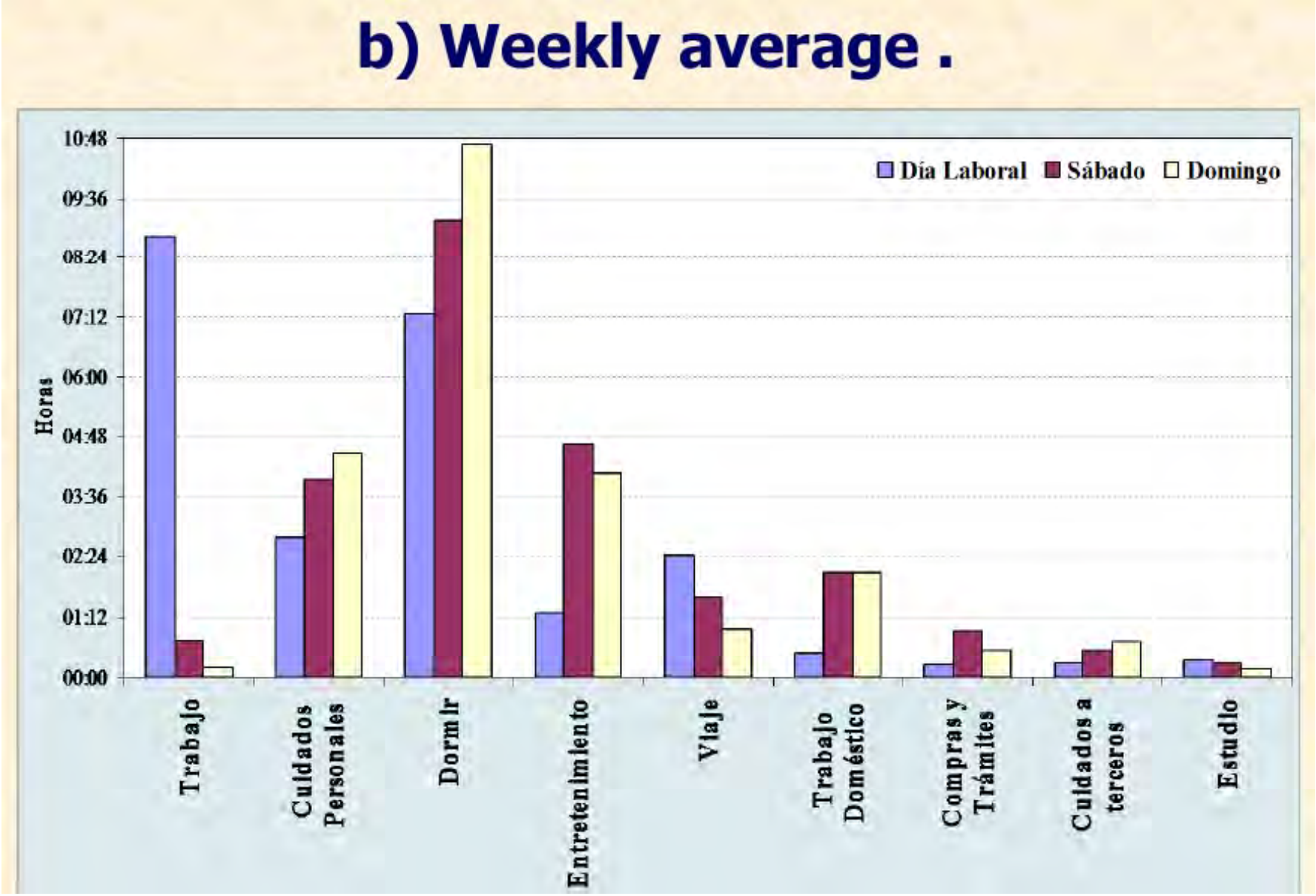


Features of the Activity-based Approach

- Views travel as a "Derived" demand
- Focus on activity participation behavior
  - Attempts to understand behavioral basis for activity participation (and resulting travel) in certain places at given times
  - Behavioral basis includes the why, how, when, where, and with whom of activity participation
- Focus on sequences or patterns of activity participation and travel behavior
  - Spatial, temporal and modal inter-dependencies in activity-travel choices recognized
  - Complexity of travel patterns recognized
  - Tours (not individuals trips) are used to represent travel patterns
- Analysis is at the disaggregate-level (i.e., individual and household-level) at which activity-travel decisions are actually made
- Appropriate treatment of the time dimension
- Emphasis on inter-personal interactions

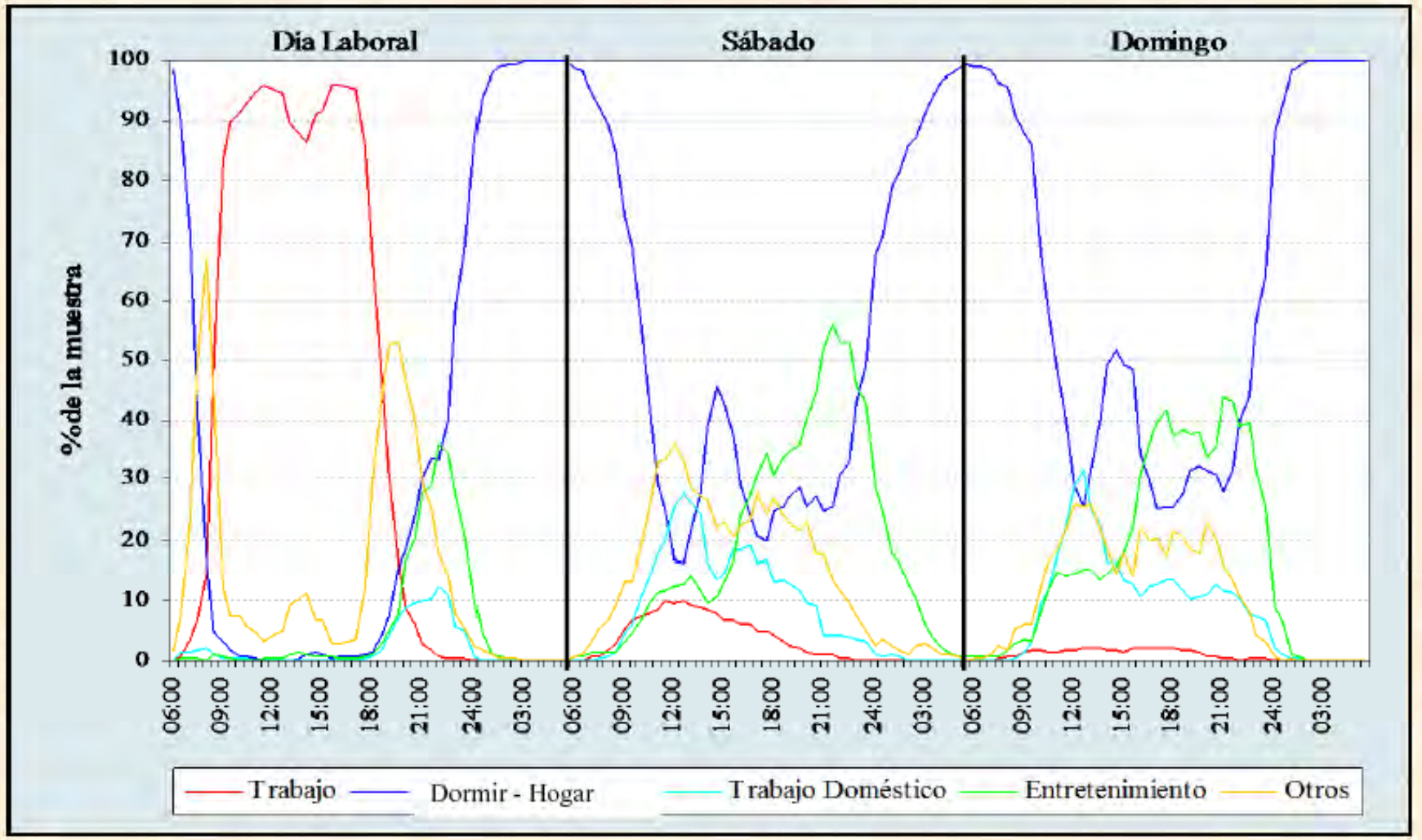
Chandra Bhat, 2008

Mobility pattern – the use of time



Mobility pattern – the use of time

c) Weekly activity pattern

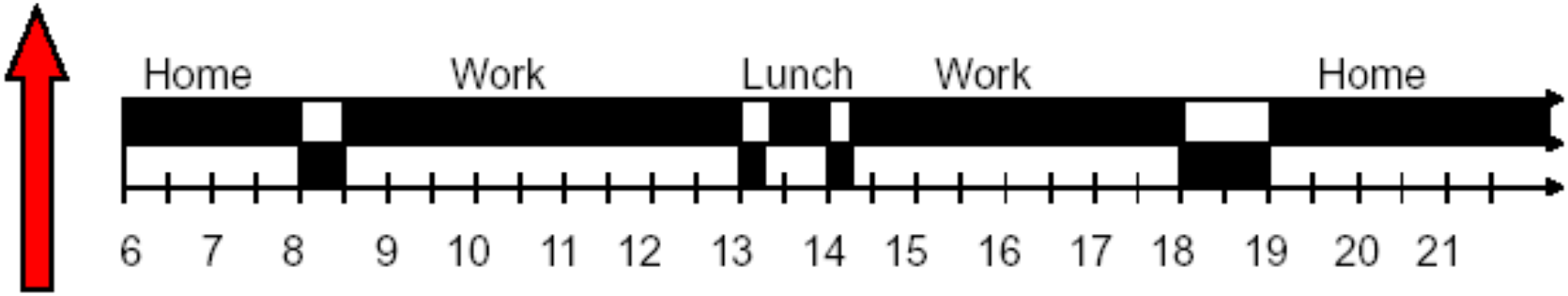


This view of mobility is more real.

The principal key in this view is the “trip chain”, or the activity travel episode in time.

INDIVIDUAL TRIP CHAIN

Time use information



Travel diary

8:00 – 8:30 Travel. Purpose: work

13:00 – 13:15 Travel. Purpose: lunch

14:00 – 14:15 Travel. Purpose: work

18:00 – 19:00 Travel. Purpose: return home

The approach that view this episode in space and time together are the “Time Geographie” (Hagerstrand 1969)

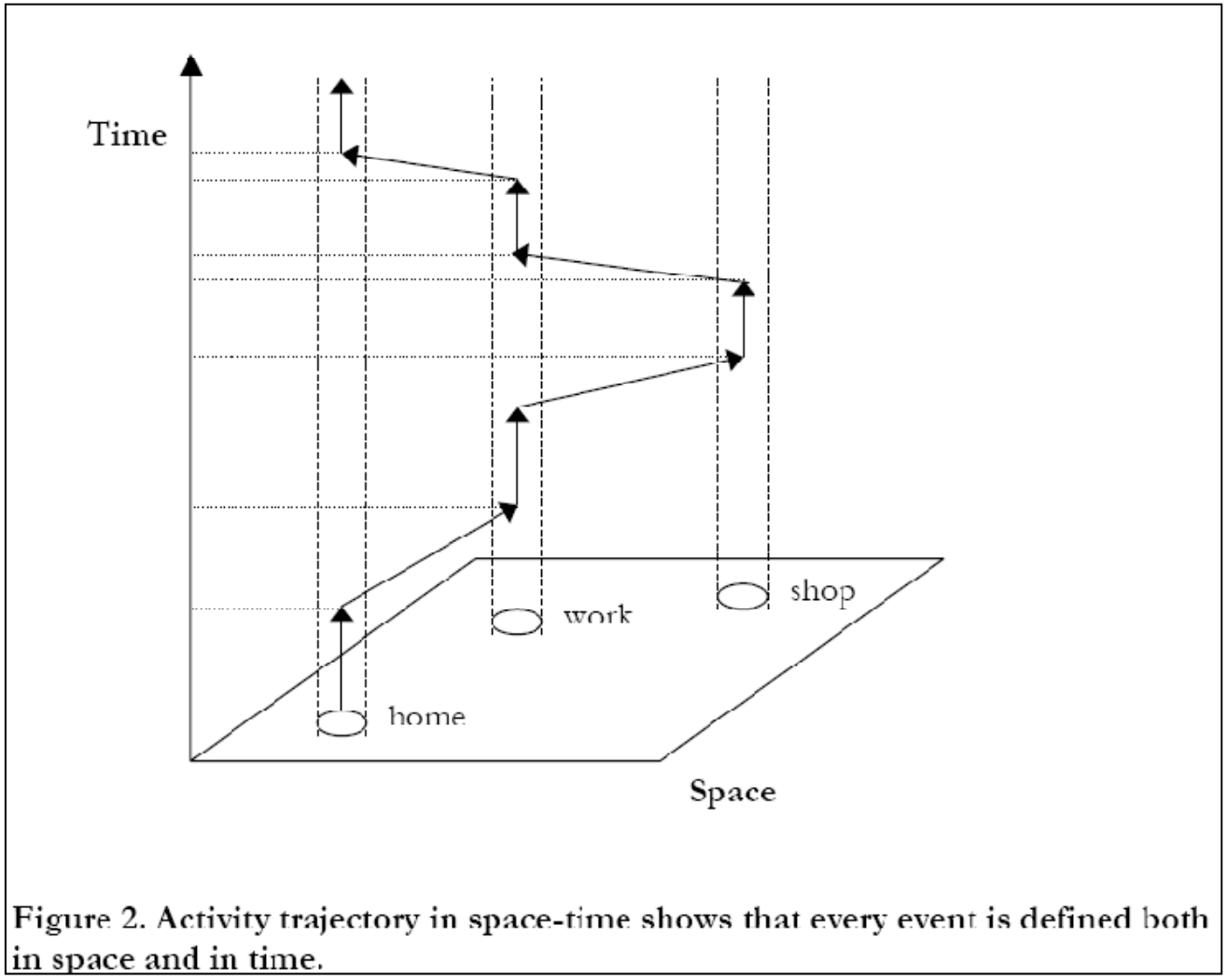
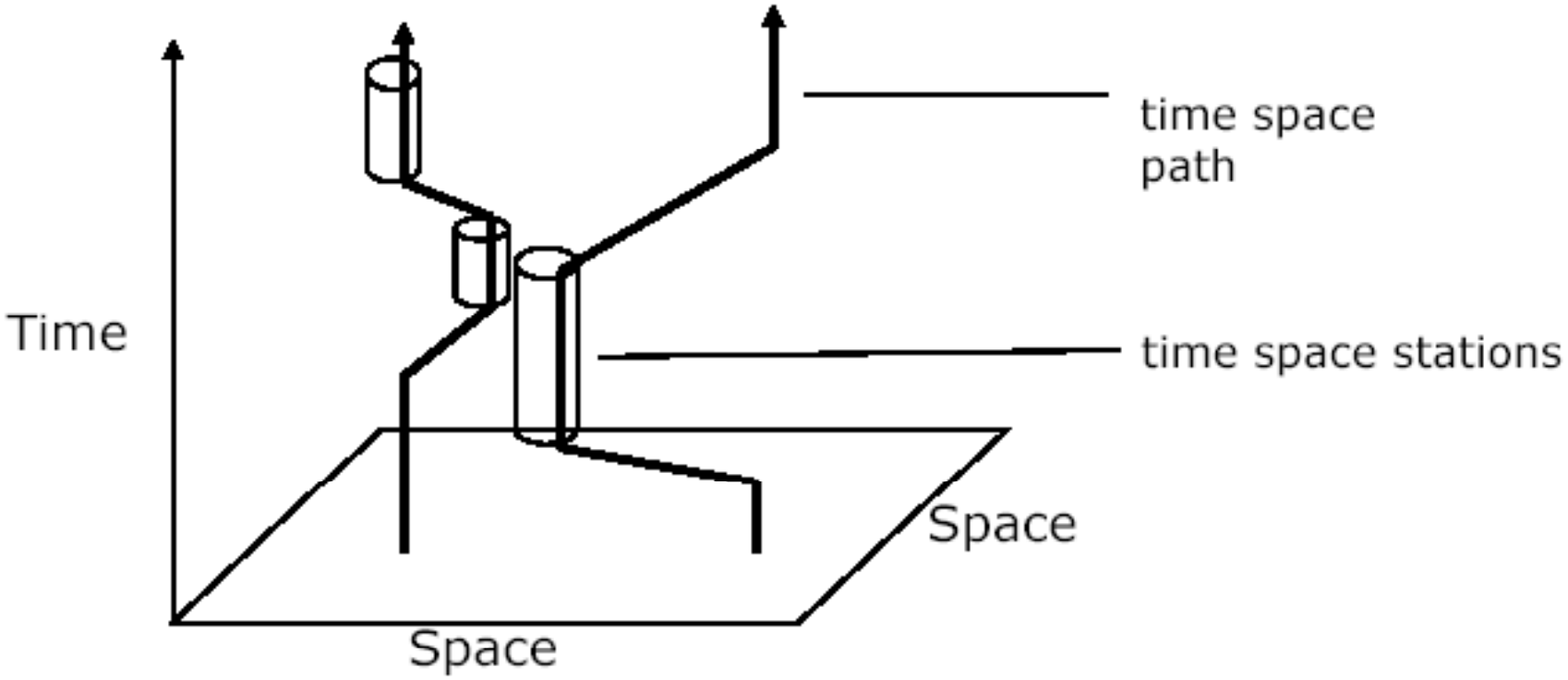
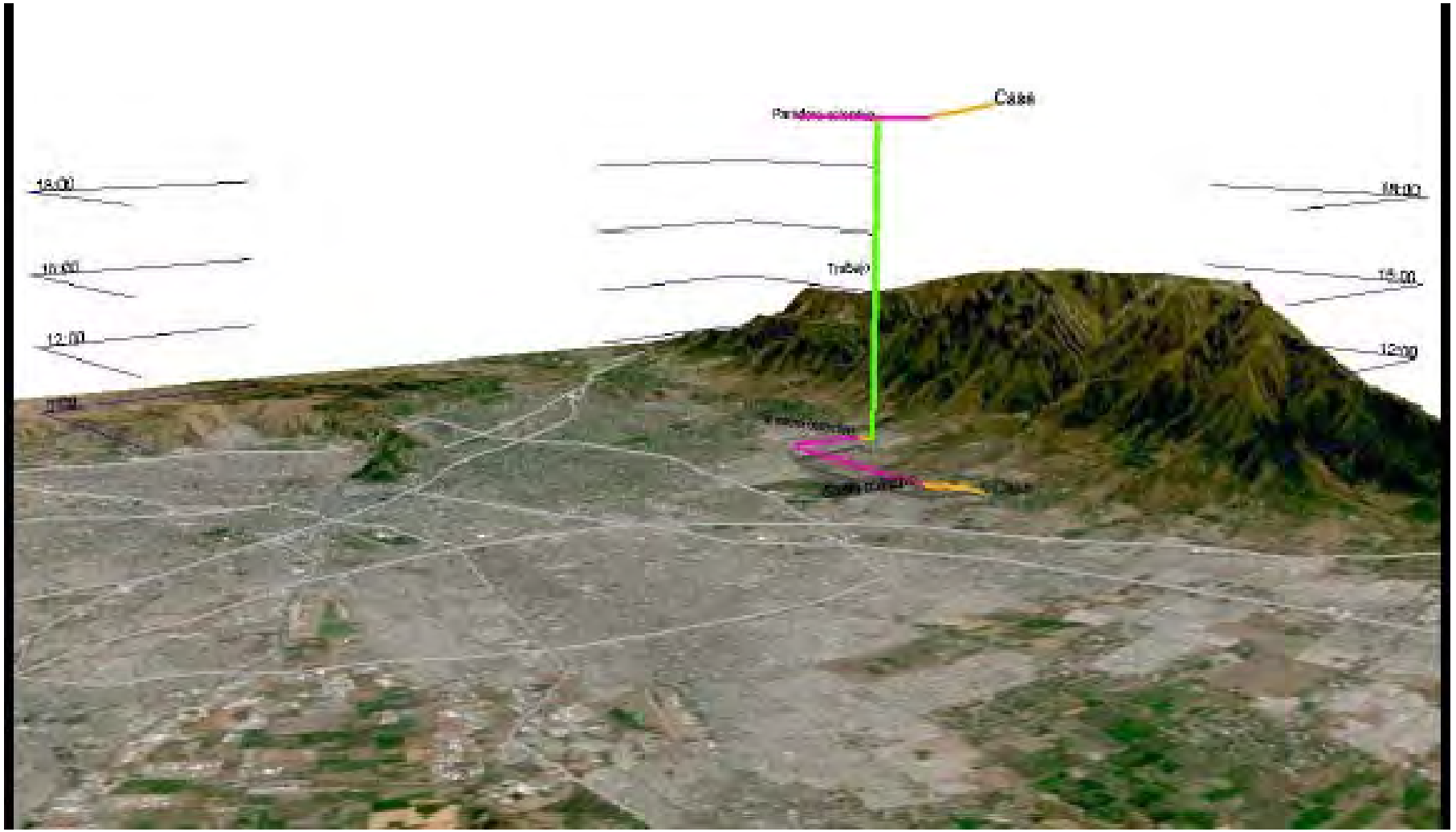


Figure 2. Activity trajectory in space-time shows that every event is defined both in space and in time.

But this realistic view of mobility is more difficult to measure and representing.

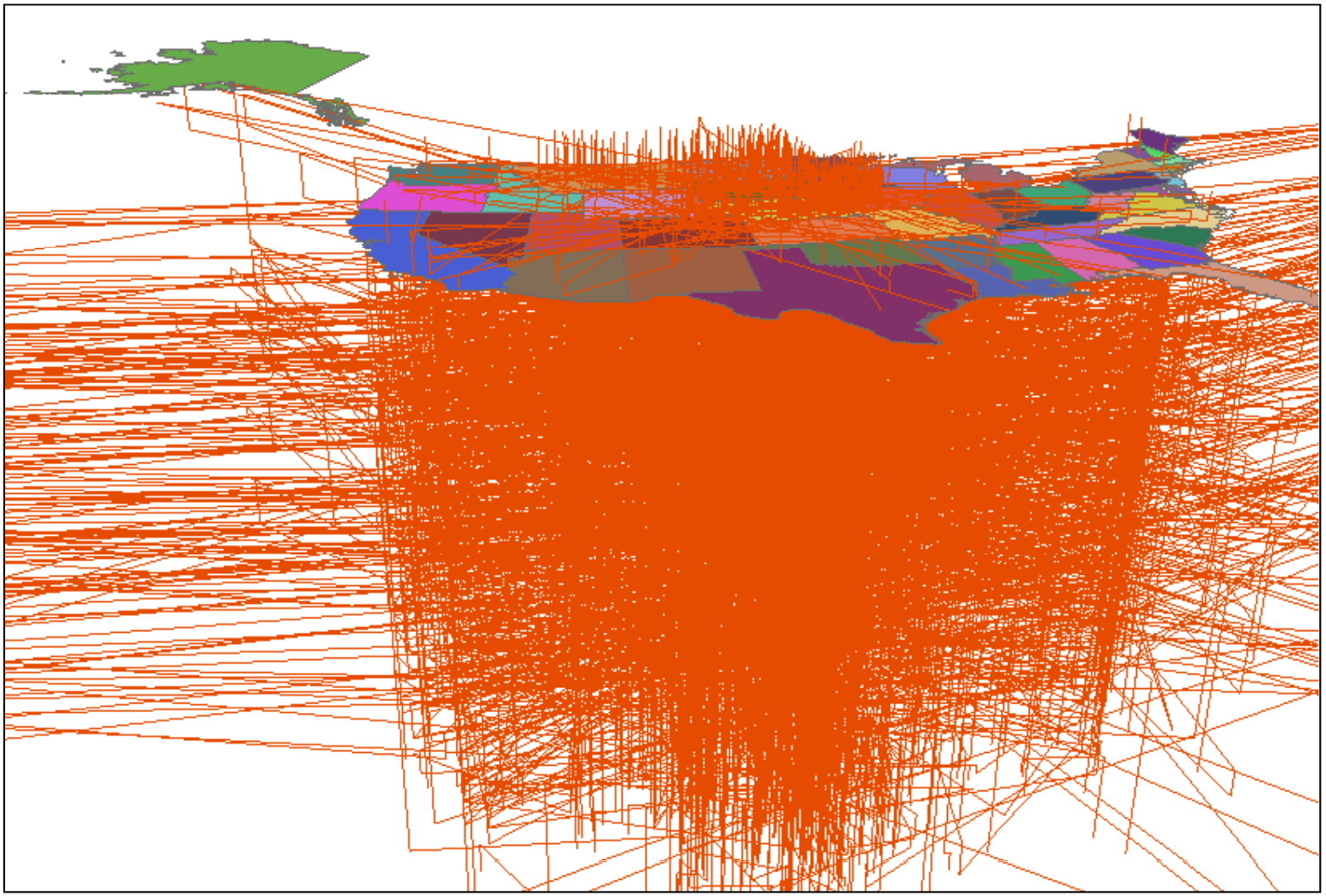


Time Geographie - Individual trip chain in space and time



Paula Jiron, 2004

Time Geographie - Individual trip chain in space and time



Shih-Lung Shaw

The must important approach of the activity based models today are the activity sheduling models

Main steps in an activity scheduling model

1. **Activity generation**: Which activities for how long?

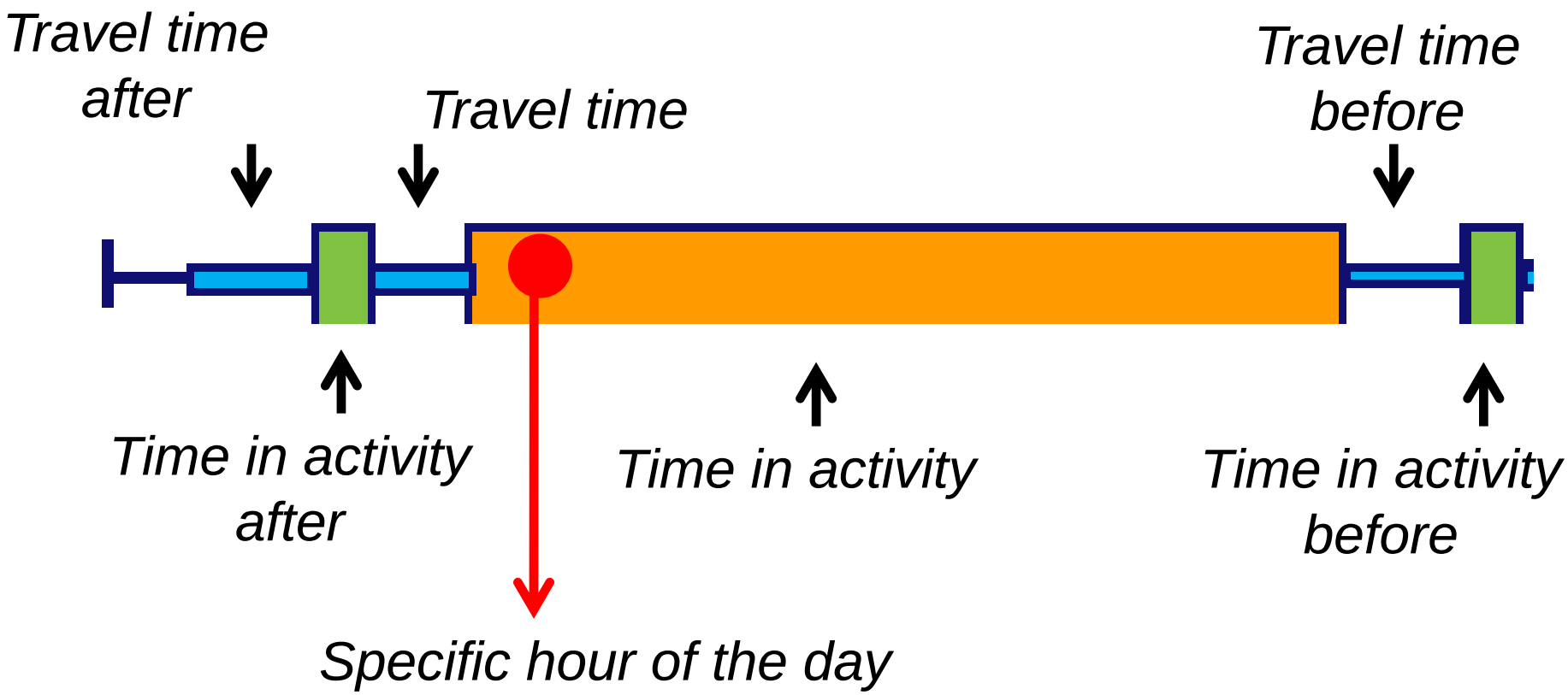
2. **Activity scheduling**: Sequence and timing of the activities?

3. **Travel choices**: Locations, trip-chaining and transport mode?

Chandra Bhat, 2008

The functional behavior of the population has relation with the “disposition to travel and to stay in a territory”, for developing an activity.

This space-time functional behavior depend the activity purpose analyzed, existing major and minor degrees of elasticity or inertia, and different type of correlation between the different times.


Travel time after
Travel time
Travel time before
Time in activity after
Time in activity
Time in activity before
Specific hour of the day

Correlations between times , Barcelona 2001

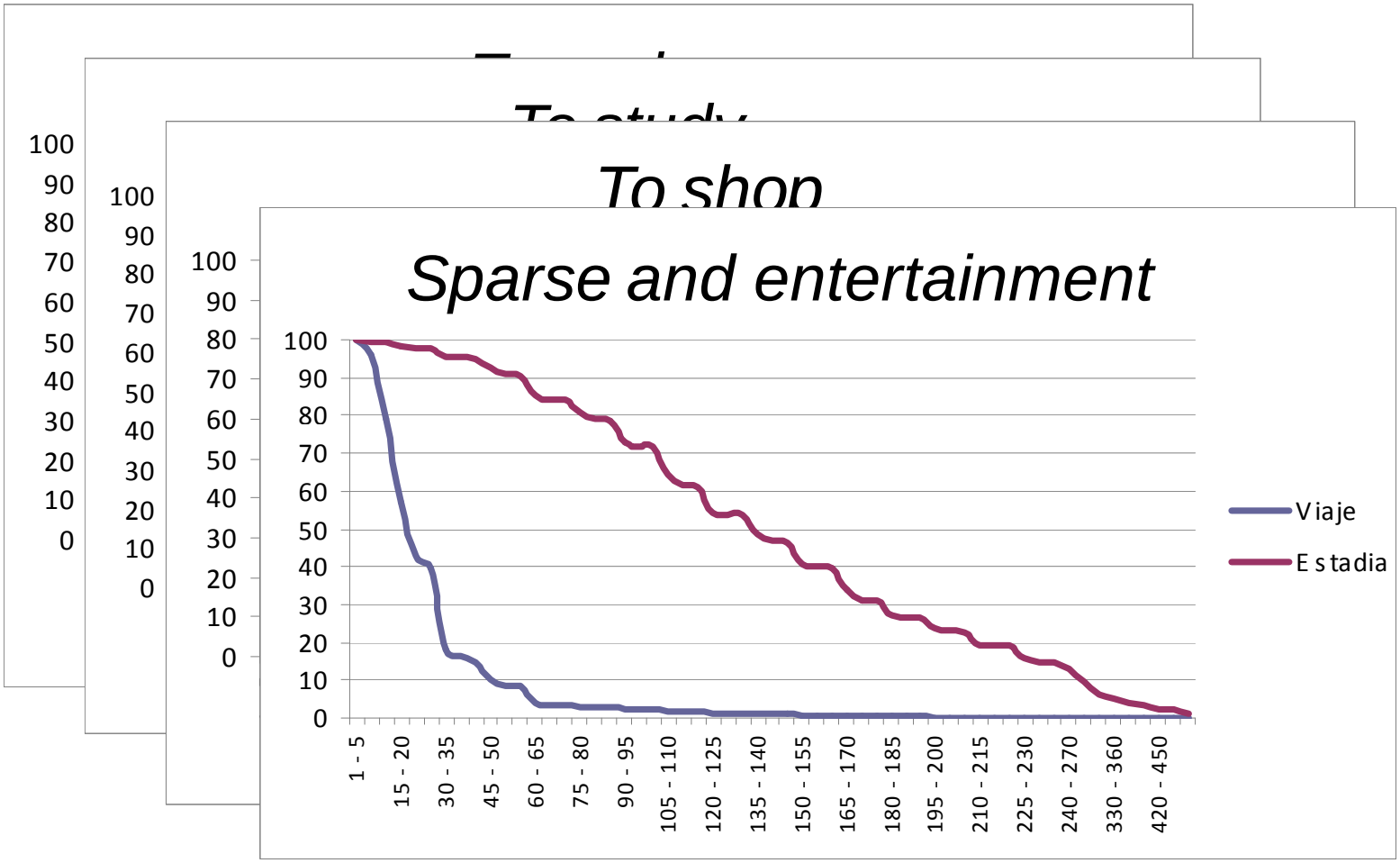
	Travel time	Time in activity
Hour of travel after	-0,038	-0,027
Travel time after	**0,488**	-0,010
Time in activity after	0,049	**-0,219**
Hour of travel	0,045	**-0,215**
Travel time	1,000	**-0,025**
Time in activity	**-0,025**	1,000
Hour of travel before	0,115	0,404
Travel time before	0,463	0,055
Time in activity before	-0,057	**-0,206**
Total travel time (day)	**0,655**	-0,116
Total time in activity (day)	**-0,571**	0,166

No correlation between travel time and time in activity

Travel time in correlation with others travel times

Time in activity in correlation with other time in activities, and hour of travel

Functional probability for time to travel and time in activity - Barcelona 2001



Finally, mobility is a social element that depends of the purpose of the interaction, and the disposition to use time in this activity.

The traditional engineering of the capacity and the technology of transport is a paradigm that must take its role in the new approach to territorial social system.

But , how can I view this “social territorial system” ?

Activity : Working

Hour : 6:00

Activity : Working

Hour : 7:00

Activity : Working

Hour : 8:00

Activity : Working

Hour : 9:00

Activity : Working

Hour : 10:00

Activity : Working

Hour : 11:00

Activity : Working

Hour : 12:00

Activity : Working

Hour : 13:00

Activity : Working

Hour : 14:00

Activity : Working

Hour : 15:00

Activity : Working

Hour : 16:00

Activity : Working

Hour : 17:00

Activity : Working

Hour : 18:00

Activity : Working

Hour : 19:00

Activity : Working

Hour : 20:00

Activity : Working

Hour : 21:00

Activity : Working

Hour : 22:00

Activity

Working

Shopping

Sparse, entret.

Hour : 06:00

Activity

Working

Shopping

Sparse, entret.

Hour : 07:00

Activity

Working

Shopping

Sparse, entret.

Hour : 08:00

Activity

Working

Shopping

Sparse, entret.

Hour : 09:00

Activity

Working

Shopping

Sparse, entret.

Hour : 10:00

Activity

Working

Shopping

Sparse, entret.

Hour : 11:00

Activity

Working

Shopping

Sparse, entret.

Hour : 12:00

Activity

Working

Shopping

Sparse, entret.

Hour : 13:00

Activity

Working

Shopping

Sparse, entret.

Hour : 14:00

Activity

Working

Shopping

Sparse, entret.

Hour : 15:00

Activity

Working

Shopping

Sparse, entret.

Hour : 16:00

Activity

Working

Shopping

Sparse, entret.

Hour : 17:00

Activity

Working

Shopping

Sparse, entret.

Hour : 18:00

Activity

Working

Shopping

Sparse, entret.

Hour : 19:00

Activity

Working

Shopping

Sparse, entret.

Hour : 20:00

Activity

Working

Shopping

Sparse, entret.

Hour : 21:00

Activity

Working

Shopping

Sparse, entret.

Hour : 22:00

Finally, with our approach we can view the mobility system in space an time.

Mobility

To work

.

To shop

Hour : 06:00

Mobility

To work

.

To shop

Hour : 07:00

Mobility

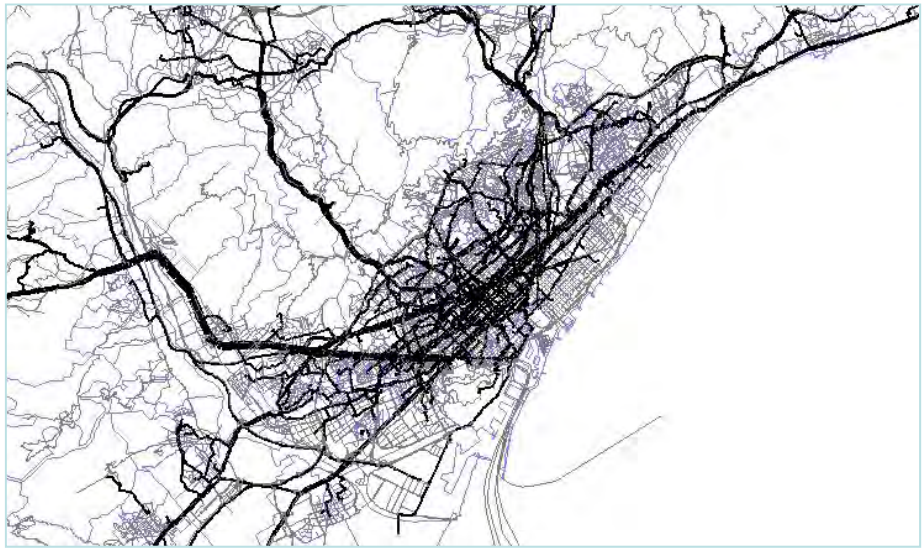
To work

To shop

Hour : 08:00

Mobility

To work



To shop

Hour : 09:00

Mobility

To work

.

To shop

Hour : 10:00

Mobility

To work

.

To shop

Hour : 11:00

Mobility

To work

.

To shop

Hour : 12:00

Mobility

To work

.

To shop

Hour : 13:00

Conclusion

Mobility is part of the social system.

The mobility pattern depend from de activity pattern, or the form that people use the city.

In this way, each transport corridor served different purposes ….so, there is a social priorization of this.

Thank you for your attention